Draft Rev. 3
2/14/03

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Integrated Surveillance Program
Implementation Guide

March 18, 2003

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1.0 Introduction

Department of Energy Standard, DOE-STD-3013-2000, governs stabilization, packaging and storage of plutonium-bearing materials, including metals and oxides of varying degrees of purity. The 3013 Standard requires that every site storing plutonium in 3013 containers develop a plan for surveillance and reporting of surveillance-related information. An Integrated Surveillance Program (ISP), described in a Department of Energy Memorandum issued July 11, 2001, "Establishment of an Integrated Surveillance Program in Support of Stabilization, Packaging, and Long-Term Storage of Plutonium-Bearing Materials", outlines the features of a single program that integrates surveillance activities at the individual sites. This Integrated Surveillance Implementation Guide seeks to clarify the activities that need to be done for compliance with elements of the Integrated Surveillance Program. These elements are identified in the attachment to the DOE memorandum, dated July 11, 2001, establishing the program.

The elements to be addressed include the following (Ref. 1):

- "A surveillance methodology for monitoring 3013 containers to detect early indications of potential failure mechanisms."
- "A process for selecting which containers in storage to examine."
- "A base set of common data fields required of all sites packaging materials in 3013 containers to assure that inventory items can be matched with potential failure mechanisms that may be detected during surveillance."

The sites that are involved in generation and/or storage of 3013 containers include RFETS, Hanford, LLNL, LANL, and SRS. Additionally, LANL has been designated as the Lead Laboratory supporting the program and the Analysis Site for destructive (and associated non-destructive) examination of the containers selected for special evaluation. The site available to provide long-term storage is SRS, while RFETS and Hanford together provide the largest quantity of containers to be stored and dispositioned.

2.0 ISP Design

The Integrated Surveillance Program is designed to provide a cost effective approach that maximizes the likelihood of detecting a potential problem with 3013 containers during long-term storage early enough to mitigate that type of problem. This ensures that the risk of breaching a container is near zero.

Integrated surveillance is linked with the plutonium packaging standard, DOE-STD-3013-2000 (Ref. 2). The relationship is described in the Integrated Surveillance Program plan document (Ref. 1). The intent is to ensure the safety of long-term storage by monitoring of storage containers, in a graded fashion, based on anticipated risk of breaching a container. This risk derives from the potential of the container's contents for pressurizing or corroding the container.

Early indications of failure are identified and characterized by selecting items, including both oxides and metals, from storage and performing non-destructive and destructive examinations of these items. Additionally, shelf-life studies using both actual and surrogate samples of stored items are performed to help in identifying items that could fail prematurely. A stratified sampling design is used for selecting the items for surveillance. The strata into which items can be segregated are differentiated from one another by their potential effects on stainless steel containers: corrosion and pressurization (corrosion only is unlikely since moisture is necessary to produce elctrolyte), pressurization only, innocuous, and other (exhibiting unforeseen effects or not well characterized). Table 1 shows this classification. The items for long-term storage will be classified by these strata (also known as "bins") which fits well with the concept of indicator populations as described in the ISP plan document (Ref. 1).

The combined *corrosive and pressure* bin consists of materials with the highest risk of a potential problem; the *pressure* bin has only with one failure mechanism and is considered to have a lower risk than the combined bin. The *innocuous* bin is considered to have a very low risk of potential problems. The *other* bin consists of materials that are not well understood in terms of failure mechanisms. This bin will be small compared to the other bins, yet due to the unknown nature of it's contents risk may be higher than for the other bins.

Stratified sampling of containers emplaced at storage sites will be based on a double sampling design. Hence, a larger number of samples will be collected for non-destructive testing and a much smaller number of samples will be drawn from this set for destructive testing. Those samples sent for destructive testing will be chosen from the non-destructive sampling set purposefully based on indications of potential problems or likelihood of potential problems. To study trends over time, each year a sub-sample of non-destructive test items from the previous year will be re-examined.

The sampling design will be evaluated each year, and adjustments made based on the results of the non-destructive and destructive testing, results of shelf-life studies, and results obtained from ongoing laboratory investigations at the Lead Laboratory and elsewhere.

A major supporting activity will include obtaining one sample of each type of item (or creation of an equivalent item using plutonium oxide plus similar impurities) for inclusion in a Shelf Life Study. This study will involve storage of actual MIS materials in instrumented containers at Los Alamos and watching for anomalous behavior. The frequency of surveillance sampling of similar (actual) 3013 Containers will be accelerated if warranted by results from this study. Additionally, results of the study can help guide decisions regarding the level of surveillance (non-destructive (NDE) versus destructive (DE) examination).

A second supporting activity planned by SRS, known as the SRS Shelf-Life Study, will place non-radioactive surrogate oxide, containing known moisture and chloride salt impurities, in 3013 Containers that have been prepared with flaws. The material will be stored in configurations and orientations that are identical to actual practice and observed for corrosion effects. Sampling and destructive evaluation of the containers at various times will presage problems with actual stored 3013 Containers.

The ISP data regarding the behavior of plutonium-bearing materials and their interaction with the 3013 container will be compiled in the ISP database. Other data in the database includes information from generating site records, surveillance records obtained during earlier storage, technology studies (including evaluation of representative samples from the generating sites), and any other relevant information. Results from the shelf-life studies and supporting evaluations (chemical interactions, corrosion, radiolysis, etc.) will also be incorporated. The goal is to have adequate information to allow cost-effective yet appropriate choices of surveillance measures by program managers. The level of confidence in the results of surveillance work should continually increase as the volume and quality of information in the database increases. The Lead Laboratory will ensure that this Implementation Guide is updated annually, or as needed, to reflect improved understanding of the technology.

2.1 Configuration and Relationship to 94-1 Program Elements

The ISP is configured within the overall program as shown in Figure 1.

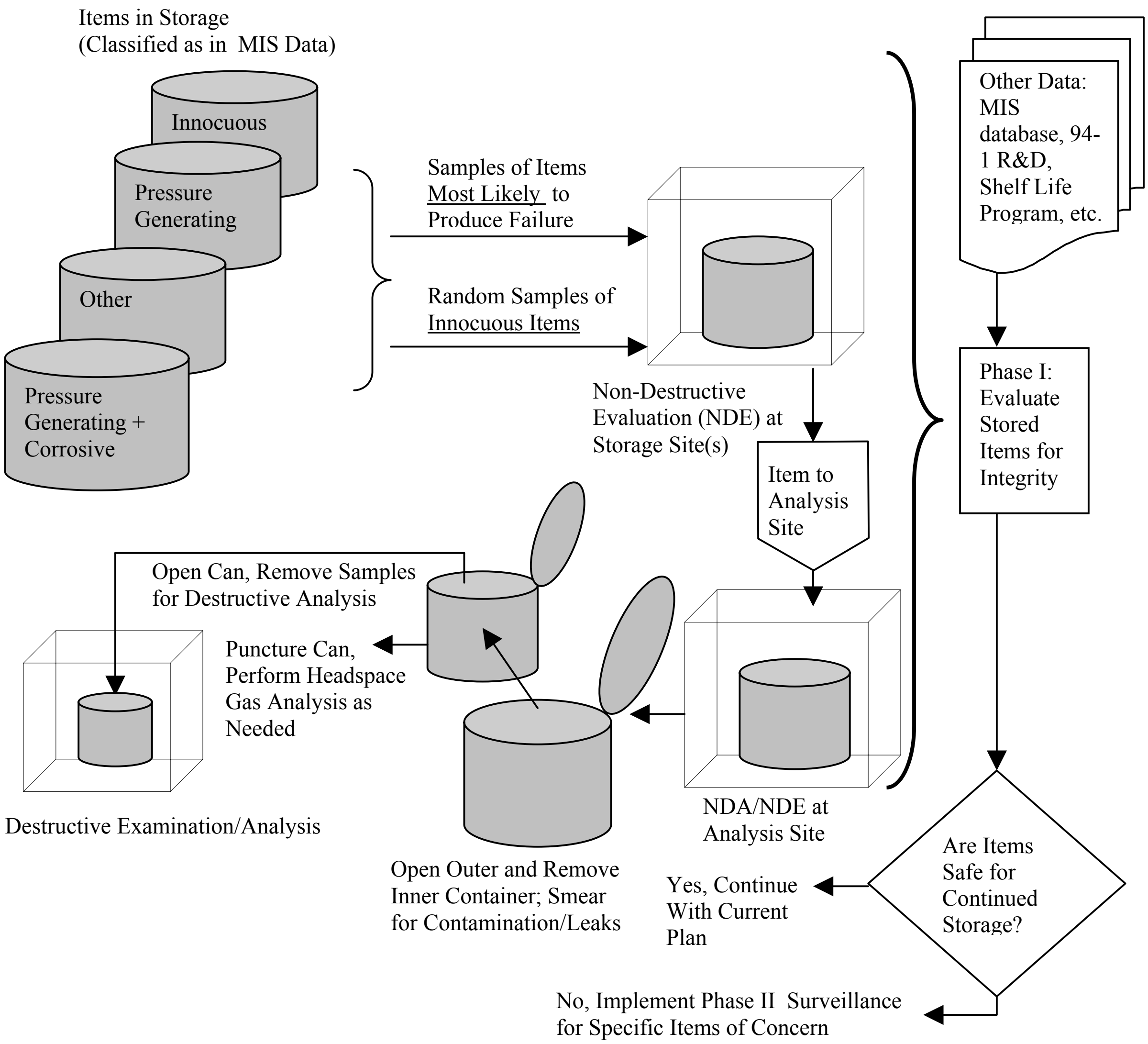

Figure 1. Integrated Surveillance Program

2.2 Responsibilities of Participants

The responsibilities of participants in the surveillance program, as defined in the ISP plan document, are summarized below (Ref. 1):

- ISP Steering Committee: This DOE group includes representatives from all participating sites, with responsibility for approving (1) non-destructive/destructive surveillance activities (annually), (2) ISP plan revisions, and (3) Phase II plans when needed. The Steering Committee also reviews (annually) results of surveillance, and reports results and findings to DOE organizations and the DNFSB, and reports (at least annually) committee decisions and observations to participating sites and DOE program offices.
- MIS Working Group: The MIS Working Group is responsible for (1) establishing the ISP approach and analytical techniques, (2) evaluating the baseline data and surveillance results, (3) establishing items for indicator populations, (4) establishing specific items and quantities for non-destructive and destructive examination, (5) providing information to the Steering Committee (annually to outline the ISP approach for the upcoming year, (6) recommending to the Steering Committee initiation of Phase II for a sub-population when needed, and (7) recommending revisions to the ISP plan document when needed.
- Lead Laboratory: The Lead Laboratory, Los Alamos, (1) facilitates implementation of the ISP, (2) maintains the database, (3) conducts specific studies to support the mission through the MIS, Shelf Life, and Core Technology programs and reports results and findings and adds data to the database, and (4) recommends future studies and item examinations in coordination with the MIS Working Group.
- Packaging Sites: The packaging sites participate in the program and include RFETS, Hanford, SRS, LANL, and LLNL.
- Responsibilities of storage sites include (1) providing storage facilities, (2) shipping selected items to the Analysis Site for examination, and (3) performing non-destructive examinations on selected items and providing results to the database. The principal storage sites are expected to be SRS and Hanford, based on volume of material to be stored (with SRS storing RFETS material in addition to SRS's own inventory).
- Analysis Site: The Analysis Site performs destructive and non-destructive analyses and data analyses. Los Alamos is currently the Analysis Site and is responsible for (1) receiving materials in 3013 containers, (2) conducting surveillance on received items and providing results to the database, and (3) performing other studies as directed by the Steering Committee or the MIS Working Group and providing results to the database. The Analysis Site is also responsible for re-stabilizing and re-packaging materials into a 3013 container and shipping items back to the storage site. In the

future the storage site may also perform analysis site duties, especially if shipping or other external factors interfere with the ability to keep up with analysis schedules at the original analysis site.

2.3 Documentation and Document Hierarchy

The guiding documents for this program include the following, listed in order of increasing depth (with the first document being the least specific).

- "Defense Nuclear Facility Safety Board Recommendation 94-1 to the Secretary of Energy", May 26, 1994: Explains the DNFSB concern with safety of stored nuclear materials.
- "An Implementation Plan for Stabilization and Storage of Nuclear Material: The Department of Energy Plan in Response to DNFSB Recommendation 2000-1, Revision 2", July, 2002, U. S. Department of Energy Office of Environmental Management: Program plan responding to DNFSB Recommendation 2001-1 (and incorporating the most recent response to DNFSB Recommendation 94-1).
- "Stabilization, Packaging and Storage of Plutonium-Bearing Materials", DOE-STD-3013-2000, September 2000, U. S. Department of Energy: Defines acceptable materials, treatments, and packaging for long-term storage of plutonium metals/alloys and compounds.
- "Integrated Surveillance Program in Support of Long-Term Storage of Plutonium-Bearing Materials", LA-UR-00-3246, March 2001, Los Alamos National Laboratory: IS program plan that describes the program and activities necessary to monitor items in long-term storage to ensure safety of workers and facilities.
- "Integrated Surveillance Implementation Guide", Draft To Be Issued: This document, intended to elaborate on the program plan, specifies actions by participating sites necessary to examine (surveillance) items, analyze results, and maintain accurate records of findings.

3.0 Phase I Surveillance

Once items are deemed to be represented by materials in the MIS Inventory, stabilized and/or properly packaged in 3013 Containers, they are sent to long-term storage. Surveillance of items in long-term storage is then initiated. Information from storage surveillance is combined with data from Shelf Life studies, MIS evaluations and Core Technology studies, and the experience of MIS Working Group members and others. The result is a clear view of the integrity of items in storage. If any information indicates a problem, especially as it may relate to the bases used to determine material preparation and/or packaging parameters, surveillance of such item(s) may be increased. In the worst case, a single questionable item or all items of a given type may require reevaluation.

3.1 Phase I Configuration

Phase I Surveillance seeks to ensure safety of stored items by selecting items to examine from the different bins or indicator populations. The numbers of samples from each bin will be determined based on the risks associated with each bin (currently estimated from experience of author; risk data can be improved in future updates of this document based on surveillance experience). The examinations will be by non-destructive and destructive means. Examinations will be by both the storage site and the analysis site. The results of Phase I will determine whether Phase II is evoked for a given item or for related groups of items. The MIS Working Group will evaluate data and recommend application of Phase II surveillance to the ISP Steering Committee.

3.2 Indicator Populations (Bins) in the MIS Inventory

The items to be selected for Phase I study will be based on the propensity for damage to the inner 3013 container. The potential failure mechanisms described in Table 5 of the Integrated Surveillance Program plan are applied to each container prepared by packaging sites. Only two principal failure modes are described: corrosion due to chemical attack on the container walls and welds, and pressurization due to decomposition of water to hydrogen and oxygen gas (concurrent with evaporation/expansion of contained moisture and with oxygen removal by reaction with substochiometric oxides of actinide elements).

Based on data from MIS evaluation of oxide samples submitted by the packaging sites, the following materials appear to be plausible candidates for indicated failure modes:

- Corrosion by Ca, Fe, Mg, Ga, Cu, Si, Al, Na, Ni, Cr, and K in the form of chloride, fluoride, or iodide salts (in the presence of sufficient moisture).
- Pressurization resulting from dehydration of metal oxides/hydroxides and chlorides, and which could be exacerbated by high decay heat and high radiation intensity from certain radionuclides that may be present.
- Innocuous behavior by materials that do not pose a concern to the integrity of the 3013 package.
- Other items that could cause container damage but are not well enough characterized to understand effects.

Items in the MIS Inventory are initially sorted (for inclusion in this ISP guidance document) by the presence of these constituents, and are classified by the most likely failure mode: (1) Innocuous, (2) Pressure Generating, (3) Corrosive and Pressure and (4) Other. A Corrosive classification, while useful for isolating a failure mechanism, is tied to the Pressure Generating classification by the need for moisture to form corrosive electrolyte and can be included in Number (3), Corrosive and Pressure. These 4 bins or strata form the indicator populations and are used to sort items for different levels of surveillance. Items in the “Other” group include materials that could cause container damage that is not currently anticipated or items whose constituents are not yet completely studied. Metals are expected to safely remain within the 3013 Container under normal conditions; hence metals fall into the Innocuous classification, together with oxides that will not pose unusual concerns.

When an item is placed into the storage queue, the item's assignment to a particular bin is reassessed (or initiated if that item has not been previously examined) by the Lead Laboratory, based on information in the ISP Database. The attached flow diagram (Figure 2) illustrates the assignment process.

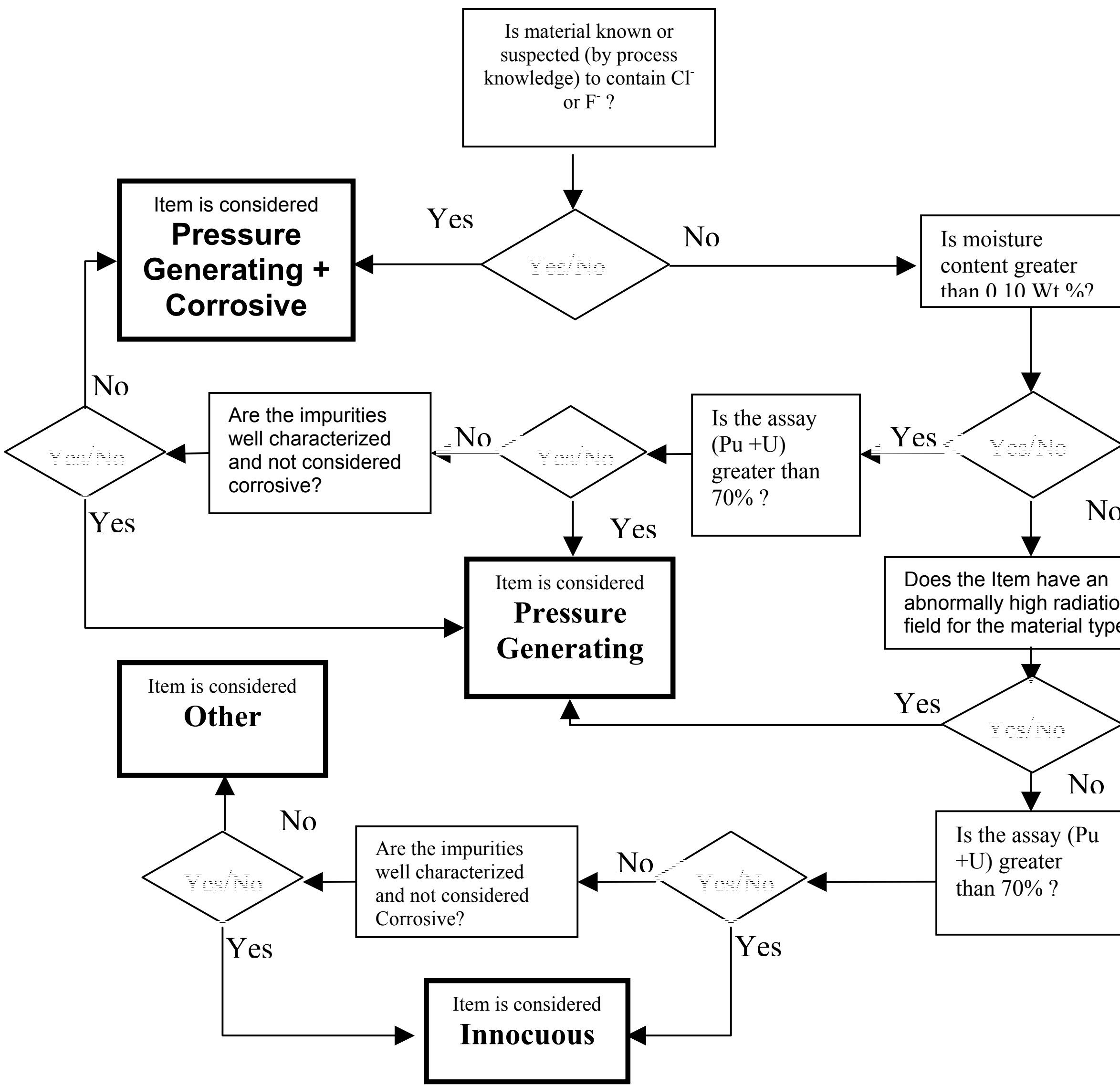

Figure 2. Item Assignment Plan

3.3 Identification of Indicator Populations and Sample Selection Criteria

It is the packaging site's responsibility to develop a listing of items to be stored and the Lead Laboratory's responsibility to identify the bin into which a given item falls. This implies that the Lead Laboratory also has a reasonable understanding of the constituents in the item and, therefore, what it's major effect on the container's integrity might be. Information is based on an item's process history and process plant source, it's radionuclide assay data, and it's analytical measurements/moisture determinations. Tables 1 and 2 of the ISP plan document identify the information needed to determine the classification of items. Prompt gamma analysis may be used to determine most constituents, in lieu of adequate process knowledge or destructive analytical chemical analyses. This is important if an item is already packaged according to 3013 requirements and no information exists about its constituents. Additionally, neutron moderation may be used to assess moisture under similar circumstances. Data for each individual item are maintained in that item's record in the MIS surveillance database. The database may then be queried by the Lead Laboratory, the MIS Working Group, and the Storage Site(s) to determine surveillance frequency and depth for that item and other similar items in the same bin.

The items expected from the individual sites are identified in Table 1. These items are assigned to bins, as described previously, in order to develop an estimate of the relative populations in each bin. The population estimates allow initial calculation of the number of samples needed to adequately assess the robustness of the containers over the life of the storage program.

Table 1. Items Assigned to Bins

Site	Item Description	Bin
Hanford	• Oxide from Product Nitrate • Oxide from CML Nitrate • Oxide from Mg(OH)2 Precip. • Oxide from Miscellaneous Solutions (Cats and Dogs) • Oxide from Miscellaneous Filtrates • Oxide from Polycubes • Product Oxide, >85% Pu • RF Oxide • Impure Oxide, 30-85% Pu • MOX • Metal/Alloy • "Other" Alloys, Sources • Oxide from Metal Brushing/Burning	• Pressure • Pressure • Pressure • Other • Other • Pressure • Pressure • Pressure & Corrosion • Pressure & Corrosion • Innocuous • Innocuous • Pressure • Innocuous
Rocky Flats	• Cast Metal Burned to Oxide • Chloride Contaminated Pu Metal Burned to Oxide • High Am Metal Burned to Oxide • High Assay Pu/Np Metal Burned to Oxide • Low Assay Pu/Np Metal Burned to Oxide • Anode Heels from Pu/Np • Free Metal Burned to Oxide • Pure Pu Oxide Produced via Aqueous Purification • Hanford PUREX Oxide • Impure Oxides Produced via Aqueous Purification • Product Oxides Produced by Burning Metal • Product Oxides: Rejects and Standards • Product Oxides: Rejects and Standards (LOI failures) • Pu/EU Oxides • Pu/Np Oxides • Byproduct Pu Oxide from MSE (IDC # 319) • Byproduct Pu Oxide from MSE (IDC # 067, 086) • Byproduct Oxides from Foundry Operations • Dissolver Heels • Solution Stabilization Mg/Pu/EU Oxides (IDC# 053 • Solution Stabilization Generated Pu Oxides	• Innocuous • Pressure & Corrosion • Pressure • Innocuous • Pressure • Pressure & Corrosion • Innocuous • Pressure • Innocuous • Pressure • Pressure & Corrosion • Innocuous • Pressure & Corrosion • Pressure & Corrosion • Innocuous • Pressure & Corrosion • Pressure & Corrosion • Pressure & Corrosion • Pressure & Corrosion • Pressure • Pressure
SRS	• Metal • Chloride/Corrosive Contaminated Oxide • Potentially Hygroscopic Oxide • Innocuous Oxide	• Innocuous • Pressure & Corrosion • Pressure • Innocuous

The requisite number of surveillance samples per bin is based on maximizing the probability of detecting a problem if one exists. The sampling strategy is based on having a probability of 95% of seeing at least one item from the worst 10% of the containers. When this sampling strategy is coupled with the expected number of items at each storage site in each bin, shown in Table 2 below, the numbers of samples and surveillance measures identified in Table 3 are needed.

Table 2. Items for Long-Term Storage

Site[1]	Innocuous[2]	Pressure Generating	Pressure and Corrosion	Other
Hanford	608	1018	480	62
SRS RFETS Totals	880 300 1180	20 151 171	10 1468 1478	0 0 0
LANL	?	?	?	?
LLNL	?	?	?	?

[1]RFETS materials are expected to be stored at SRS; hence the surveillance requirements at SRS are for the combined inventory.
[2]Includes metal as well as oxides.

Table 3. Surveillance Sample Selection

Sample Classification	Relative Risk	Surveillance at Storage Site	Surveillance at Analysis Site	Number of Samples[1]
Innocuous	Low	• Visual Inspection • NDE: Lid Deflection, Outer Can Smear.	• NDA/NDE • DE	- Hanford: 1 (NDE at HF) - RFETS/SRS: 2 (NDE at SRS)
Pressure Generating	Moderate, Risk = 10x Innocuous	• Visual Inspection • NDE: Lid Deflection/Pressure Sensor (HF Site), Outer Can Smear, NMI.	• NDA/NDE • DE • Headspace Gas	- Hanford: 25 (17 NDE at HF, 8 NDE Samples in LANL Shelf Life Program) - RFETS/SRS: 4 (3 NDE at SRS, 1 NDE Sample in LANL Shelf Life Program)
Pressure Generating and Corrosive	High, Risk = 20x Innocuous	• Visual Inspection • NDE: Lid Deflection/Pressure Sensor (HF Site), Outer Can Smear, NMI, Prompt Gamma if needed, Weight • NDA.	• NDA/NDE • DE • Headspace Gas	- Hanford: 7 (3 DE at HF, 4 NDE in LANL Shelf Life Program) - RFETS/SRS: 22 (11 DE at SRS, 11 NDE in LANL Shelf Life Program)

Other	Unknown Risk = 100x Innocuous	Same as Pressure Generating and Corrosive	Same as Pressure Generating and Corrosive + TBD.	- Hanford: 24 (12 DE at HF, 12 NDE in LANL Shelf Life Program) - RFETS/SRS: 0

[1] Initial sampling estimate; may be modified as items are evaluated during item storage process.

Samples for surveillance are recommended to the ISP Steering Committee by the MIS Working Group (in response to suggestions from the Storage Site(s), the Lead Laboratory, or the Analysis Site). There are different surveillance frequencies and depths of analyses depending on the level of risk and on the type of measurements available, with non-intrusive measurements being more economical and safer to perform but not as revealing.

A direct application of the LANL Shelf Life Study involves using small-scale containers, instrumented to measure pressure as well as certain corrosion effects, with samples pulled from items sent for storage. This is highly beneficial since analysis for corrosion cannot be performed on actual containers without opening the containers and surveying corrosive damage. In lieu of destructively analyzing containers in the Pressure and Corrosive bin, data from small scale shelf life studies could be substituted. A few actual containers could be destructively analyzed each year to verify the reliability of this technique. Similarly, a set of samples from the Pressure bin could be placed in the small-scale shelf life containers and monitored in lieu of NDE of all actual containers. The suggested split of actual and shelf life samples is:

- Pressure bin: Prepare 9 shelf life samples and select 20 actual samples for NDE (2 actual samples per year). The shelf life samples should be interrogated more frequently for the first 5 years of the program (once per month the first year, once per every two months during years 2 through 4, and twice per year thereafter). Each shelf life sample should be from a different type of item in the Pressure bin.
- Pressure and Corrosion: Prepare 15 shelf life items and select 14 actual items for DE (1 the first year, 2 in each year for years two through five, and 1 every year thereafter). The 15 shelf life samples should reflect different types of items if possible, and should not require DE due to the use of NDE (imbedded corrosion monitors). If shelf life samples are opened for DE, they should be replaced for continued NDE during the life of the program.
- Other: Prepare 12 shelf life samples and select 12 actual items for DE. The shelf life samples can be evaluated using NDE unless an unexpected result is obtained, in which case DE should be considered for that item. Record shelf life data every month for the first year, once every two months during years 2 through 4, and twice per year thereafter. Perform 2 DE of actual stored containers, selected from different types of items, in each of the first two years, then 1 DE every year thereafter.
- Innocuous: Perform NDE on at least1 Innocuous item, selected randomly, in year one, and at least 1 NDE every 5 years thereafter on randomly selected containers.

Supporting information from the shelf life studies will help in improving the depth of analyses and frequency of surveillance for particular types of items that exhibit tendencies to fail earlier than initially expected. The ISP Steering Committee will review all data to assess surveillance measures during the duration of the program. Included are initial item packaging data, previous surveillance data, shelf-life study data, and data acquired from actual surveillance measurements.

3.4 Data Collection Requirements and Selection of Analytical Methods

Data will be collected in the MIS database from the initial evaluations done by the Packaging Sites and from the surveillance work done by the Storage and Analysis Sites. The data to be acquired for samples packaged for long-term storage are shown in Tables 1 and 2 in the ISP plan document. Data to be collected during surveillance include information identified in Tables 3 and 4 of the ISP plan and/or other information for which methodology is becoming available. Table 4, below, shows analytical methods that fulfill surveillance needs and that are generally available.

Table 4. Surveillance Methods

Parameter	NDE Method	NDA Method	DE Method
Inner Container Pressure	• X-Ray Radiography/Lid Deflection • Inner Can Pressure Puck (Sensor/EM Signaling)	----------	Can Puncture/ΔP
Outer Container Pressure	Visual Examination/ Container Irregularities	----------	Can Puncture/ΔP
Outer Container Integrity	• Contamination Smear • Leak Check/Vacuum • Weight	----------	Open Can/Visual Inspection
Inner Container Integrity	----------	----------	• Contamination Smear (Inside of Outer) • Contamination Smear (Outside of Inner) • Inner Container Evaluation: Visual Examination, Metallography/Microstructure Analysis, Etc.
Moisture Content (Diagnostic Test for potentially Pressurized Cans)	Neutron Moderation	----------	• LOI • TGA • SFE • IGA
Constituents	Prompt Gamma	• Calorimetry • Gamma-Ray Isotopic Analysis	• Actinide Assay • ICP-MS

			• XRF • XRD • Etc.
Weight	Balance	----------	Balance
Headspace Gas Composition	----------	----------	Can Puncture Plus MS and/or Raman Spectroscopy

The key tests for items that appear to be questionable, by virtue of their contents or by results of non-destructive examinations, are the destructive examinations, including can puncture pressure/composition and inner container evaluations. Can puncture tests will indicate pressurization and build-up of undesired gases such as H2 or Cl2. Container evaluations will indicate stainless steel degradation and formation of pits, cracks, or scaling due to corrosive attack. Together these will show whether effects of oxide impurities were correctly estimated and, if not, what further analyses are needed to determine longevity of the storage container . Results will be used , together with data generated by supporting studies and experiments (e.g., correlation of pit formation depth with composition and time, shelf-life study results, etc.) , to configure the elements of Phase II surveillance of specific types of items.

3.5 Data Analysis and Decision Methodology

Once data are acquired, the MIS Working Group, with input from the Lead Laboratory, Analysis Site, and Storage Site, evaluates the information to determine if any items or constituents of items need further examination. If information is anomalous, further evaluation can be requested and an item, or type of item, can be placed in a mode of enhanced surveillance. This can range from increasing the risk level and associated surveillance measures in Phase I Surveillance to increasing sampling frequency and evaluation depth to Phase II Surveillance levels (if a container failure occurs or concerns about continued safe storage of a given item or type of item surface).

The following diagram illustrates the data flow for the surveillance program. In this depiction, information accompanies an item as it goes into the storage queue. The item is arrayed for storage and the surveillance clock begins to tick. Simultaneously, a similar item is arrayed in the Shelf Life Program at Los Alamos and, possibly, in surrogate form at the SRS Shelf-Life Lead Experiment. Data flow is into the MIS Database for use by the ISP Steering Committee and the MIS Working Group. Feedback from the ISP Steering Committee to the Surveillance Program’s operators allows adjustment of surveillance frequency or depth of analyses and modification of this plan as necessary.

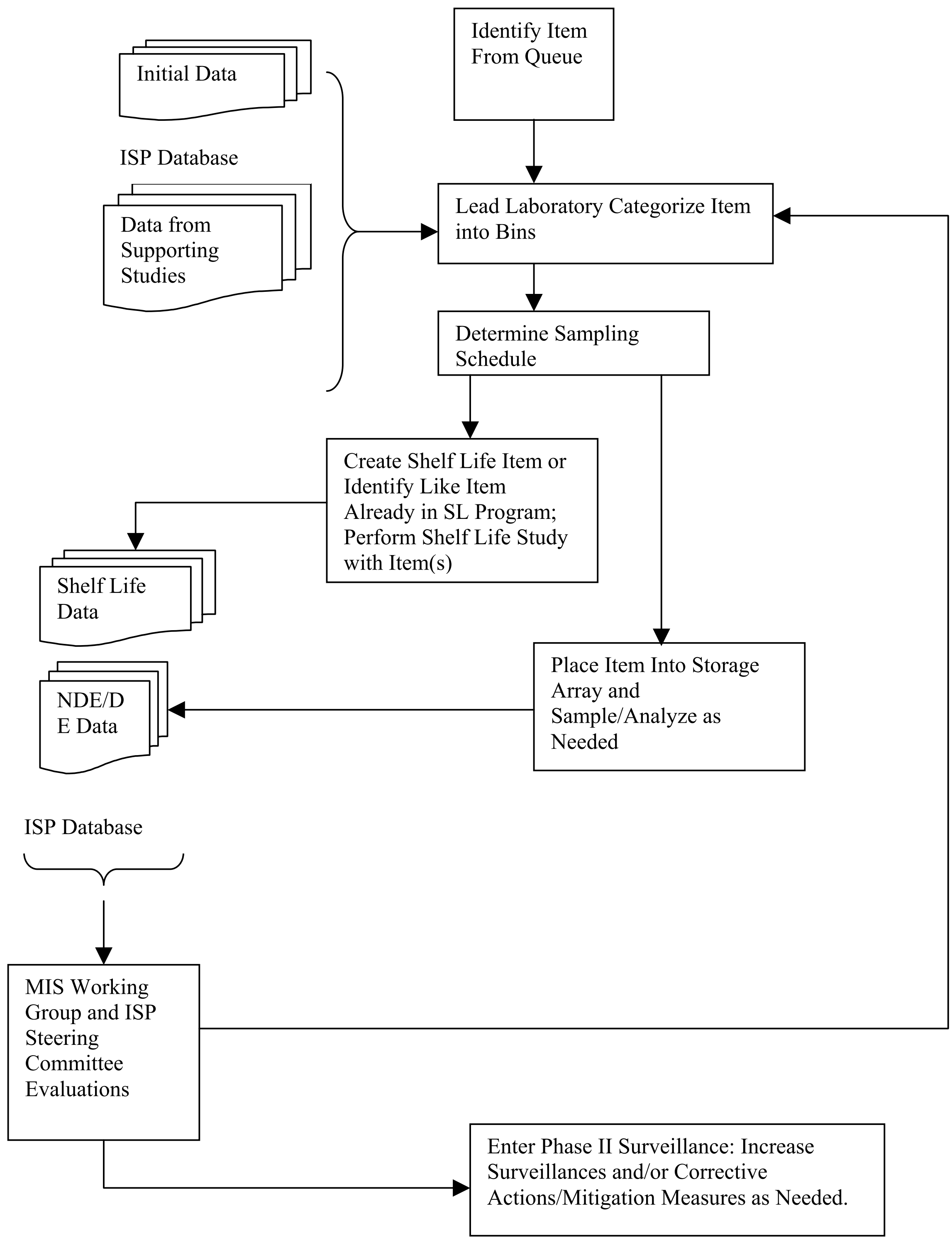

Figure 3. Data Flow in Surveillance Program

4.0 Phase II Surveillance

4.1 Phase II Configuration

4.2 Determination of At-Risk Population

4.3 Enhanced Evaluation Measures

4.4 Enhanced Evaluation Design Methodology

4.5 Analysis of Results and Disposition Options

4.5 Selection of Optimal Disposition Path

5.0 Conclusions

6.0 References

1. "Integrated Surveillance Program In Support of Long-Term Storage of Plutonium-Bearing Materials", LA-UR-00-3246 Rev. 1, Los Alamos National Laboratory, March 2001.
2. "Stabilization, Packaging, and Storage of Plutonium-Bearing Materials", DOE-STD-3013-2000, US Department of Energy.
3. "Represented Items in the MIS Project", Los Alamos National Laboratory, DRAFT, May 9, 2002.